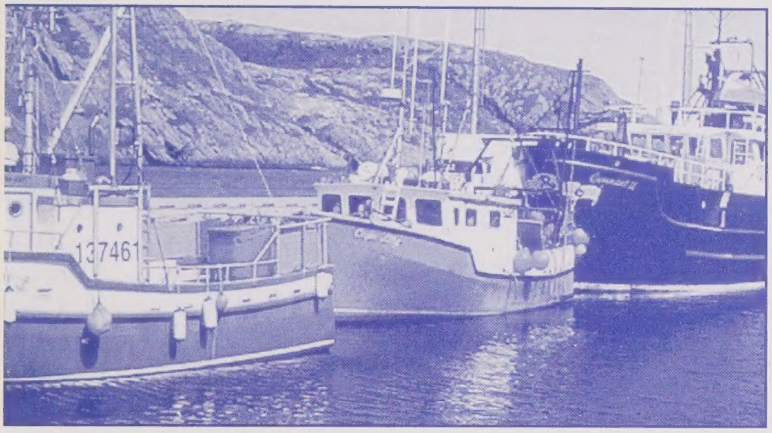
A D I A N F I S H E R I E S

# ESPONSIBLE SHERIES

M M A R Y

*"Reduction of Fossil Fuel Energy Intensity in the Canadian Fishing Industry"*

**2000-2001 Annual Report**
**May, 2001**



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- New composite trawl netting offers potential fuel savings in the order of 2,330,000 liters per annum for shrimp trawler fleet
- Use of new small diameter high tenacity braided polyethylene twines in trawl netting demonstrates potential annual fuel savings of 850,000 liters in Silver Hake fishery alone, compared to standard polyethylene
- Testing of new Triplex Trawl design, with three codends instead of one, indicates a reduction of about 13% in fuel consumed per kilogram of fish harvested
- Greenland Halibut (Turbot) selectivity experiments show that new "Millennium" trawl design using small mesh size in forepart and body of trawl effectively reduces meshing and decreases by-catch of small Turbot, thus reducing operational costs and fuel consumed
- Shrimp Selectivity by-catch grid design using plastic covered stainless steel wire instead of traditional stainless steel shows potential benefits of lighter weight materials of construction

CANADIAN FISHERIES

# RESPONSIBLE FISHERIES

SUMMARY

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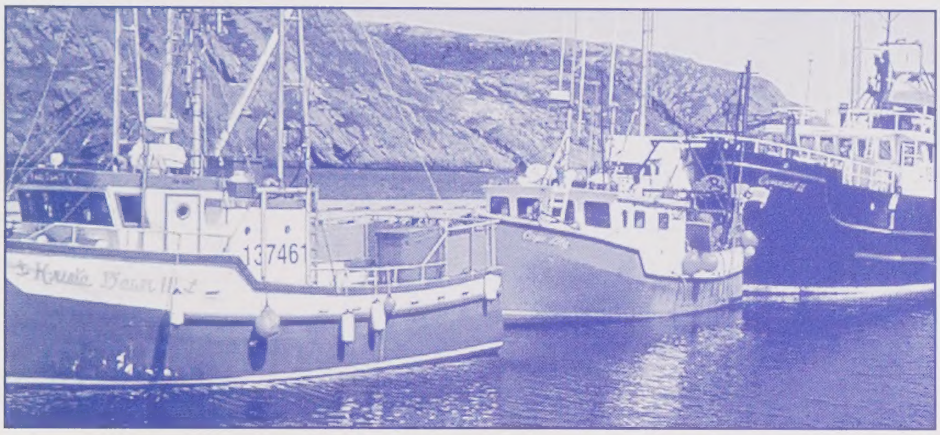

## Co-operative Research Efforts Between Industry and Government Focus on the Reduction of Fossil Fuel Energy Intensity in the Canadian Fishing Industry

### Introduction

Harvesting fish from the sea requires more energy than the production of any other primary food product. Recent increases in fossil fuel prices and the growing concern over greenhouse gas emissions have highlighted the need to investigate ways of improving energy efficiency in the fishing industry.

By all estimates, the majority of the energy requirements associated with the fisheries are clearly in the fish harvesting sector. The Department of Fisheries and Oceans, Fisheries Management, Responsible Fishing Operations Division, in collaboration with industry partners and with support from the Program of Energy Research and Development (PERD), Natural Resources Canada, have completed several initiatives to improve the energy efficiency of fishing gear and related components. Five projects have been completed in the period from April, 2000 to March, 2001, and two more are underway, to design and test the performance of new gear prototypes and fishing techniques to determine their effectiveness for reducing energy consumption. Projects typically involved development of detailed experimental protocols, gear prototypes, flume tank testing, at-sea trials, analysis of results, and reporting to industry and stakeholders.

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***Trawling is one type of fishing technology which provides significant opportunities for improvements in energy efficiency. Two methods of improving the fuel efficiency of fishing trawls are:***

1. ***Reduce towing drag or resistance - by using smaller diameter twines or lighter materials of construction for gear materials***
2. ***Decrease fuel consumed per kilogram of fish harvested - by development of new gear designs such as those which minimize by-catch, or result in a larger area of the sea or lake bottom being swept per hour of towing (e.g. increasing the horizontal mouth opening of the trawls), and thereby increase catch rates, especially if such enhanced trawl geometry is achieved with minimal or no corresponding increases in drag.***

## An Evaluation of the Fuel Consumption and Fishing Performance of a Composite Shrimp Trawl

Shrimp trawling is conducted on both coasts of Canada, and it is the most fuel intensive sector in the fishing industry. This is primarily due to the small mesh size and higher towing resistance of shrimp trawls, combined with the smaller catch rates relative to other trawl fisheries. For example, near-shore shrimp trawlers in the New Brunswick shrimp fleet presently consume from 40 to 60 litres per hour, and average fuel costs have increased as much as 60% to 70% over the past 12 months.

As a result, a project was undertaken on the Shrimp Trawler M.V. "Dominic Francis" operating from Caraquet, New Brunswick and fishing in the Gulf of St. Lawrence, to evaluate the impact of the use of alternate netting materials in shrimp trawls in place of the traditional polyethylene material on energy and fishing efficiency.


*Project Vessel*
*M.V. Dominic Francis*

### *Project Objectives*

The long-term objective is to develop trawls with at least 10% less drag or towing resistance compared to traditionally constructed trawls of the same size.

Specific goals of this project were to evaluate the impact of the use of alternate netting materials in shrimp trawls in the net, and the diameter of the twines and ropes used in its construction, on energy and fishing efficiency.

Towing resistance, fuel consumption, trawl geometry, and fishing performance of a composite trawl constructed from Spectra, nylon and polyethylene were tested and compared against a standard polyethylene shrimp trawl of the same shape and size.

Spectra is a synthetic fibre which has a tensile strength similar to steel cable. As a result, Spectra twine in a trawl can be 50% thinner than polyethylene twine of the same strength. This will therefore result in more efficient trawls which can be towed with less power and energy consumption.

In addition, Spectra netting has a high wet knot strength, in contrast to knots in polyethylene netting which lose about 20% of their dry knot strength.

### *Project Details*

The experiment was conducted on fishing grounds off Anticosti Island in the Gulf of St Lawrence. The tests occurred during two commercial fishing trips during August and September 2000, which provided 17 days at sea with the equivalent of 15 fishing days.

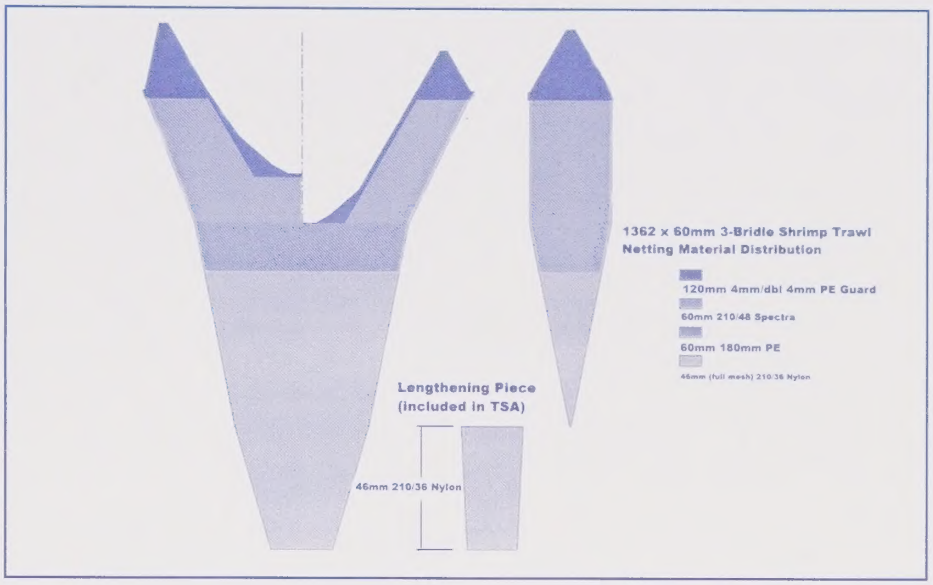
The identical design used in constructing both the polyethylene and Composite shrimp trawls was a three bridle Nordsea Labrador type #1362, which has a 1360 x 60 cm mesh size. The same Bison #13 trawl doors and identical ancillary equipment were also used with both types of trawls. Preliminary estimates indicated that the Composite trawl had approximately 40% less twine surface area. In addition, a scale model of this trawl was constructed and tested in the flume tank at the Marine Institute of Memorial University in St. Johns, Newfoundland.

During each tow, fuel consumption, gear geometry and gear tension were monitored with electronic sensors and all such data was stored electronically for later analysis. Environmental conditions and shrimp catches were also recorded.

### *Results*

The average performance of these two trawls during the 50 fishing tows is shown below:

**Nordsea Labrador type #1362 Composite Shrimp Trawl**




**Experimental Results**

| Trawl Netting Material | Poly Twine Only | Composite | % change |
|---|---|---|---|
| Gear Tension (kg) | 3690 | 3380 | - 8.4 |
| Door Spread (m) | 41.8 | 46.0 | + 10.0 |
| Wing Spread (m) | 16.75 | 17.17 | + 2.5 |
| Headline Height (m) | 9.861 | 9.865 | + 0.04 |
| Swept Area (m3) | 323,000 | 334,000 | + 3.4 |
| Fuel - Liters / Hour | 60.5 | 54.6 | - 9.75 |
| Shrimp Catch / hr (kg) | 458 | 485 | + 5.9 |
| Catch / liter of fuel | 7.57 | 8.88 | + 17.3 |
| Liters of fuel/ kg shrimp | 0.1320 | 0.1126 | - 14.7 |

The decrease in the towing resistance of the Composite trawl netting was actually greater than is implied by the measured gear tension. Previous tests have indicated that on average, about 25% of the drag after the doors is due to the sweeps, foot-rope and floats, and about 75% is caused by the netting. Since only the netting was changed in the two trawls, and since the gear tension measured after the doors decreased by 8.4%, this suggests that the drag force of the Composite net itself was reduced by about 8.4/0.75 = 11%.

### *Spectra/Nylon Twine:*

- ***Lower towing resistance***
- ***Larger Catch Rates***
- ***Larger door and wing spreads***
- ***Reduced Fuel Consumption***

The results show that the use of Spectra/Nylon twine in this trawl resulted in lower towing resistance, as well as larger door and wing spreads compared to the similar trawl constructed of only polyethylene twine. The larger shrimp catch rates were probably the result of these increases in door and wing spreads, and the resulting larger swept areas.

***This improved performance in both towing resistance and higher shrimp catch rates, resulted in fuel savings of 0.0194 liters/kg of shrimp during fishing operations. In other words, the use of Spectra/Nylon twine in the shrimp trawl resulted in average fuel savings during fishing of 14.7% per kilogram of shrimp.***

### Benefits to the individual vessel owner

The shrimp fishery in which this experiment was conducted is managed on the basis of individual boat quotas. Based on these results, it is projected that the use of Composite netting could result in annual fuel savings for this vessel of about 7,910 liters (i.e.: 407,800 kgs shrimp x 0.0194 liters/kg saved) or close to $3,900 per year (based on fuel prices in 2000) in fuel alone. Fuel savings may actually be larger than this since the resulting higher catch rates might possibly result in fewer fishing trips per year.

A Composite trawl of this type could cost about $6,000 more than one constructed of polyethylene. The "payback period" for this additional investment would therefore be slightly more than one fishing season, based only on the $3,900 or more in fuel savings! If we add the savings from the other hourly operating expenses (e.g.: lube oil, equipment wear, etc.) for such a vessel, then the payback period could be in the order of only one fishing season. After this, the benefit would be additional profits.

### Benefits to the environment

In addition to the economic benefits to the individual boat owner, the reduction in fuel consumption from the use of Composite trawls will also result in reduced emissions of greenhouse gases, which is now a global priority.

***Estimated fuel savings from the use of such trawls could amount to 19.4 litres per metric ton of landed shrimp. Since current shrimp landings on both coasts of Canada are currently about 120,000 mt per annum, this suggests potential fuel savings in the order of 120,000mt x 19.4 liters/mt = 2,330,000 liters per annum if all shrimp trawlers used Composite trawls.***

***It should also be noted that significant fuel savings could also be achieved by incorporating Composite twine in groundfish trawls, which could result in major fuel savings within these fisheries on both coasts.***

Finally, the lower resistance and wider opening characteristics of Composite nets suggests that the use of smaller and lighter doors might be possible with such nets. The most noticeable impact of trawls on the sea bottom are the "tracks" caused by the bottom edge of doors. Such sea bottom impacts would therefore be reduced with the use of smaller doors.

### Project Participants

- The Department of Fisheries and Oceans, Responsible Fishing Operations, supported by PERD funding.
- Captain Daniel Gionet, the owner and operator of the MV "Dominic Francis", the shrimp trawler used for these experiments.
- Nordsea Limited of Dartmouth, Nova Scotia.
- The Marine Institute of Memorial University, St. Johns, Newfoundland, supported by the Canadian Center for Fisheries Innovation.
- The New Brunswick School of Fisheries in Caraquet.

## Comparison of the Drag and Fishing Performance of Two Types of Polyethylene Netting in Silver Hake Trawls

Another fishery which could benefit from improvements in energy efficiency is the Silver Hake fishery. Nova Scotia based trawlers involved in the nearshore Silver Hake fishery are 13 to 20m in length and consume from 11 to 15 gallons per hour. Reducing the towing drag or resistance of trawl nets is a very effective approach for improving fuel efficiency in this type of fishing method. One method for achieving such reduced drag is by using smaller diameter twines in the trawl netting.

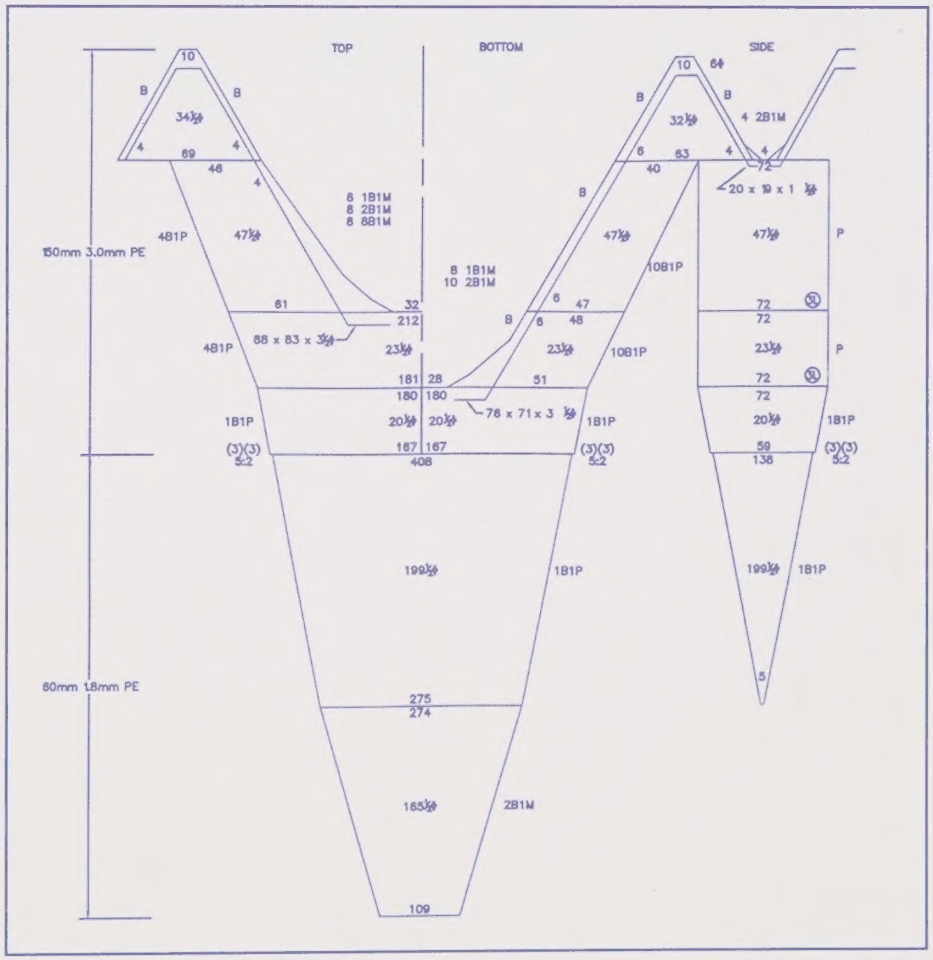
Tricolor Elite High Tenacity Braided Polyethylene is a new netting material which is thinner and stronger per unit weight than the traditional or Regular Braided Polyethylene material. A project was undertaken to evaluate the impacts on energy and fishing efficiency from the use of this new Tricolor Elite netting in Silver Hake trawls in place of the Regular Polyethylene Braided material.

The vessel used in this project was the "Carmelle III" which operates from West Pubnico, Nova Scotia, and the experiment was conducted on commercial fishing grounds at the Emerald Bank on the Scotian Shelf in September/October, 2000.

The trawl designs were two bridle Nordsea Silver Hake type; the fishing circle was 504 x 15 cm mesh size. Both trawls were identically designed and constructed and selectivity grids were used. The trawl doors and ancillary equipment were also identical.

*Project Vessel*
*M.V. CARMELLE III*

### Nordsea Silver Hake Trawl



### *Project Results*

Results of the at-sea trials are summarized below:

| Type of Polyethylene Netting | Regular Braided | Tricolor Elite High Tenacity Braided | % change |
|---|---|---|---|
| Gear Tension (kg) | 3,150 | 2,890 | -8.3% |
| Door Spread (m) | 35.4 | 37.3 | +5.4% |
| Wing Spread (m) | 14.66 | 14.77 | +0.8% |
| Headline Height (m) | 5.88 | 6.04 | +2.7 |
| Swept Area (m3) | 278,000 | 315,000 | +13.3 |
| Fuel Liters / Hour | 53 | 53 | 0% |
| Hake Catch / hr (kg) | 350 | 500 | +42.9% |
| Catch (kg) liter fuel | 6.6 | 9.4 | +42.9% |

In comparison with the trawl constructed with *Regular Braided Polyethylene* twine, the trawl constructed with *High Tenacity Braided Polyethylene* twine provided the following performance improvements:

- The gear tension was 8.3% less. The decrease in the towing resistance of the trawl netting was actually greater than is implied by the measured gear tension. Previous tests have indicated that on average, about 25% of the drag after the doors is due to the sweeps, foot-rope and floats, and about 75% is caused by the netting. Since only the netting was changed in the two trawls, and since the gear tension measured after the doors decreased by 8.3%, this suggests that the drag force of the *Tricolor Elite* net itself was reduced by about 8.3/0.75 = 11%.

- The door spread, wingspread, and headline height were increased by 5.4%, 0.8% and 2.7% respectively.

- The swept area increased by 13.3%.

- Although the measured gear tension decreased by 8.3%, there was no corresponding reduction in the fuel consumption rate of the engine. This could have been caused by a variety of factors encountered during the trials including significant changes in sea and wind conditions which can also cause appreciable variations in the power requirements to simply propel the vessel. Significant marine slime accumulated on the fishing gear during several trips and this had a marked impact on the net geometry and towing drag.

  Nevertheless, the theoretical power required to tow a trawl is equal to the towing tension times the towing speed relative to the water. Since the tension measurements were averaged for varying current conditions, one might reasonably assume that under ideal experimental conditions, the energy requirement to just tow the trawl constructed *Tricolor Elite* polyethylene trawl could be about 11% less than with the regular polyethylene trawl. This is a substantial energy saving!

- The average hake catch per hour, and the catch per liter of fuel used, increased by 42.9%. This is probably because of the larger swept area achieved with the improved trawl geometry provided by this netting material.

***If such higher catch rates are typical of trawls constructed with this material, then this may be the major source of future energy and economic savings in this fishery. For example, the annual quota for Silver Hake on the Scotian Shelf is currently 20,000 mt. In theory, if all the trawlers in this fishery increased their catch rates from 350 to 500 kg/hour, then this quota could be caught with about 17,000 less hours of towing. With an average fuel consumption of 50 liters/hour, this would imply a total annual fuel savings of about 850,000 liters for this fishery alone.***

The additional cost of a trawl made with Tricolor Elite is estimated to be less than $1,000. This similarity in trawl prices is explained by the fact that even though the price of the high tenacity netting is more per kilogram, the netting for such trawl is lighter (331 vs. 368 kg). As well, the twine surface area of the trawl constructed of standard polyethylene was estimated to be 84.7 m2 compared to the 59.3 m2 surface area of the Tricolor Elite trawl, a reduction of over 42%.

***The truly large potential for fuel savings from the use of modern netting materials such as Tricolor Elite polyethylene and Spectra, however, will be in all of the other Canadian groundfish and shrimp trawl fisheries.***

The results indicate that the new netting does hold potential for fuel savings when compared with standard polyethylene. The technology of compacted netting is progressing and soon there will be netting produced with an even better ratio of twine diameters to increase further the efficiency of this product against standard polyethylene.

### *Project Participants*

- The Department of Fisheries and Oceans, Responsible Fishing Operations, supported by PERD funding.
- Captain Aubrey d'Entremont of the MV "Carmelle 3" and Inshore Fisheries Ltd. Of West Pubnico, Nova Scotia, the vessel owners.
- Nordsea Limited of Dartmouth, Nova Scotia.
- The Marine Institute of St. Johns, Newfoundland, supported by the Canadian Center for Fisheries Innovation.

## Comparison of the Energy and Fishing Efficiency of Widebody Triplex and Standard Single Trawls in the Great Lakes

One approach to decreasing fuel consumed per kilogram of fish harvested is the development of a gear design which could result in a larger area being swept per hour. In response, Nordsea Limited has developed new Duplex and Triplex trawl designs having two and three codends, respectively. The design objective was to provide trawls having the advantage of a wider horizontal opening (i.e. foot-rope spread) than a standard single trawl, with a correspondingly smaller vertical opening (i.e.: headline height). *(Illustrated in Exhibit 1.)*

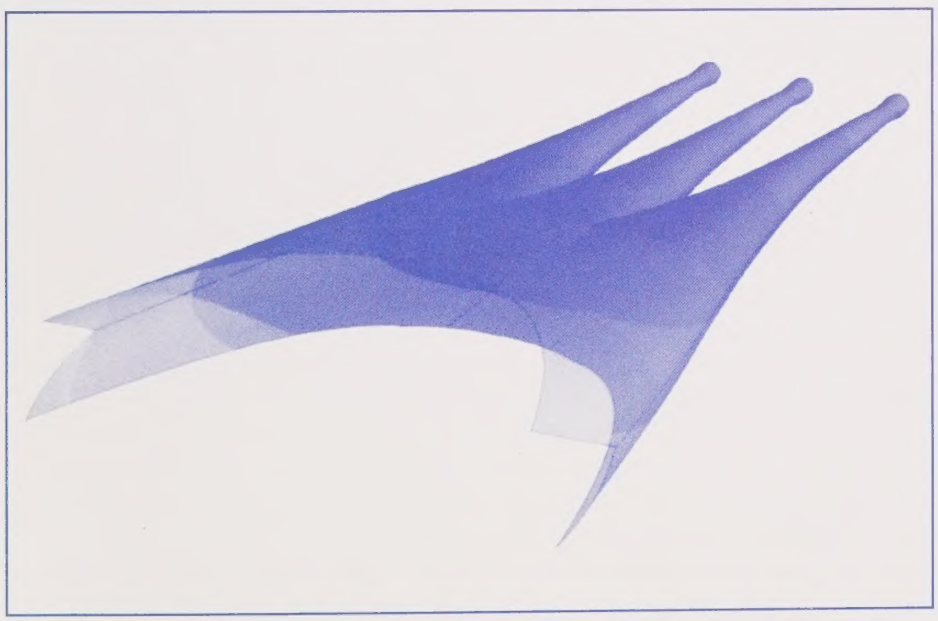


*Exhibit 1 - Triplex Trawl*

A comparison of the estimated frontal view geometry of a standard trawl with one codend and the new Triplex and Duplex trawl design is illustrated in Exhibit 2.

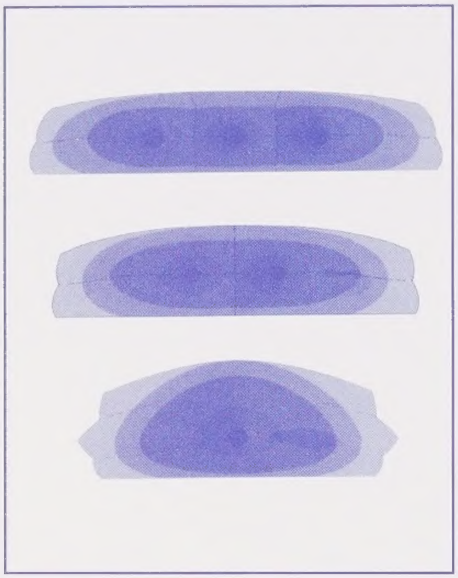


*Exhibit 2 - Front end Comparison*

These Duplex and Triplex designs were expected to provide:

- Significantly less drag compared with a standard trawl having a comparable horizontal opening (i.e. wing spread).
- An increased foot-rope spread comparable to that achieved by twin trawls. This offers a "middle road" alternative to owners that for financial or technical reasons are unwilling to convert to twin trawling.
- An improvement in fishing performance and energy efficiency, particularly when targeted fish species, which are located near the bottom, and where headline height (i.e. the height of the net mouth opening) is not a priority.

Preliminary performance evaluations of these new designs were first obtained by:

1. Nordsea's trawl simulation computer program, and by
2. Extensive testing of models in the flume tank at the Marine institute in St. Johns, Newfoundland.

Computer simulation and flume tank tests indicated that the Duplex and Triplex designs might offer up to 20% and 47% more swept area, respectively, compared with equivalent single trawls. It was also expected that these increases in swept area should also be achievable with minimal or no increase in towing drag forces. Such improved hydrodynamic performance is expected since 30 to 60% less netting is required in these new designs as compared to that needed to achieve a similar foot-rope increase in traditional trawls with one codend.

In addition, high strength netting materials such as Tricolor Elite is thinner and stronger per unit weight (as described in the previous project) and offers advantages in terms of further reduction of hydrodynamic resistance.

The objective of this project was therefore to compare the towing resistance, fuel consumption, trawl geometry, and fishing performance of two trawls through experimental trials in this freshwater fishery:

1. A standard trawl with one codend, constructed of regular braided polyethylene.
2. A new Triplex trawl design having three codends, and constructed from tricolour Elite High tenacity Braided Polyethylene.


*Project Vessel M.V. "Leonard S"*

### *Results*

At-sea trials were conducted aboard the vessel "Leonard S", which is a steel trawler operating from Port Dover, Ontario. The experiments were conducted during nine days of commercial fishing activity in Lake Erie during late October, 2000. The performance of these two types of trawls averaged over the seven tows conducted with each type is summarized as follows:

### Experimental Results

| Type of Trawl | Standard Trawl With Polyethylene | Triplex With Tricolor Elite | % Change |
|---|---|---|---|
| Gear Tension (kg) | 1,750 | 1,890 | + 8.0% |
| Door Spread (m) | 65.0 | 49.5 | - 23.8% |
| Wing Spread (m) | 29 | 22 | - 24.1% |
| Headline Height (m) | 3.79 | 3.43 | - 9.5% |
| Swept Area (m3) | 105,000 | 75,000 | - 28.6% |
| Fuel - Liters / Hour | 35.82 | 36.19 | + 1.0% |
| Commercial Fish Catch /hour (kg) | 2,224 | 2,535 | + 14.0% |
| Non-commercial Fish Catch / hr (kg) | 5 | 55 | |
| Catch Value /hour | $905 | $965 | + 6.6% |
| Commercial Catch (kg) / liter fuel | 62 | 70 | + 12.9% |

Results of these experiments can be summarized as follows:

- The Triplex trawl had a 71% greater mouth circumference than the single trawl (i.e.: 9,030cm vs. 5,280cm) however, it could be towed with an increase in gear tension of 8% with only 1% more fuel consumption per hour.

  This suggests that the hydrodynamic drag efficiency of the larger Triplex trawl, and its resulting energy efficiency, is significantly better than a standard trawl with a similar mouth opening. In other words, a trawler with a given engine horse power could tow a much larger Triplex trawl compared to a traditional trawl with one codend.

- Based on initial computer simulations and flume tank tests, it was suggested that the larger mouth opening of the Triplex trawl could result in a significantly larger swept area (i.e.: up to 47% more) compared to a standard trawl, and a correspondingly significant decrease in headline height (i.e.: up to 32% less). Actual testing showed that, the measured wing and door spreads with the Triplex trawl were 24.1% and 23.8% less than those of the standard trawl, respectively, and the headline height was only 9.5% less. It should be noted, however, that these wing and door spread measurements are not the same as the foot-rope spread, which is the true measure of the actual sea or lake bottom which is being swept. In fact, it was suspected that the Triplex trawl was being over spread and that this trawl might operate better with smaller doors, which would most likely reduce the overall gear drag, thereby reducing engine loads and fuel consumption. Alternately, a bigger Triplex trawl could be towed with the existing engine and doors, resulting in higher catch rates per liter of fuel used.

- Although the Triplex trawl might not have been operating in an optimum way, it still provided a 14% higher catch rate of commercial fish species as compared to the standard trawl (i.e.: 2,535 kg vs. 2,224 kg/hr.). This resulted in a 6.6% increase in the catch value per hour of towing (i.e.: $965 vs. $905).

The improved fishing performance of the Triplex trawl is thought to be the result of its more effective mouth geometry. For example, the mouth opening of a standard trawl is similar to a triangle with rounded corners, with the maximum headline height at the center of the net. As a result, most of the fish are captured at the center of a standard trawl. In contrast, it is thought that the mouth geometry of the Triplex net is more like a rectangle with rounded corners, which provides a more uniform catching potential across the whole foot-rope.

This theory appeared to be verified in the experiments since about 50% of the catches in the Triplex trawl were in the center codend, whereas only 25% of the catch was in each of the side codends.

The additional catch revenue provided by the Triplex net amounted to $60 per hour of fishing. This was achieved with an increase in fuel consumption of only 0.37 liters per hour, which is negligible.

***In summary, this experiment showed that even when its operation was not optimized, the Triplex trawl could reduce the fuel consumption per kilogram of harvested fish by about 13% in this Great Lakes trawl fishery. This demonstrates the significant energy savings potential of this new trawl design.***

Further testing and refinements of this Triplex trawl are required to have it operate properly as designed. This will include adjustments to ancillary equipment such as the use of appropriate doors. It is reasonable to expect, however, that the fishing and energy savings performance of this new trawl design will eventually be substantially better than was achieved in these preliminary experiments.

*Triplex Codends (Full)*

### *Project Participants*

- The Department of Fisheries and Oceans, Responsible Fishing Operations, supported by PERD funding.
- Nordsea Limited of Dartmouth, Nova Scotia.
- Captain Rick Misener of the M.V. "Leonard S", and president of Mitowmar Ltd., the vessel owners.
- The Marine Institute of St. Johns, Newfoundland.

## Greenland Halibut (Turbot) Selectivity Experiments to Reduce By-Catch of Small Turbot

Canadian fishers involved in the Greenland halibut (turbot) offshore trawl fishery have had difficulty in keeping the by-catch of small turbot (<45 cm) to under 15% of the total catch as required by the regulations, despite the requirement to use a 145 mm mesh codend. When the catch of fish is greater than 15%, the vessel may have to move to another part of the fishing grounds to obtain the vessel's quota, increasing time at sea and fuel costs, or the fishery may be closed for an indefinite time period. The industry is fully aware of the need to conserve the resource and the need to reduce the environmental impact of greenhouse gas emissions, and as such is concerned about the impact that the use of traditional gears and the requirement to move to new grounds has on the resource and the quantity of fuel used.

Fishers are therefore continually seeking new ways to reduce the by-catch of small turbot in order to efficiently harvest vessel quotas without violating the small fish protocol and ensure more energy-efficient operations. In 1998, industry in conjunction with the Department of Fisheries and Oceans (DFO) conducted selectivity work aimed at assessing the effect of a change in mesh size in a portion of the forward part of the trawl, and the introduction of a panel of plastic coated netting in the codend on the capture of small turbot. However, while some of these efforts showed promise, more work is required to produce a system that will significantly reduce the capture of small, undersize turbot and related operational and fuel costs.

### *Experimental Trials with the new "Millennium" Trawl*

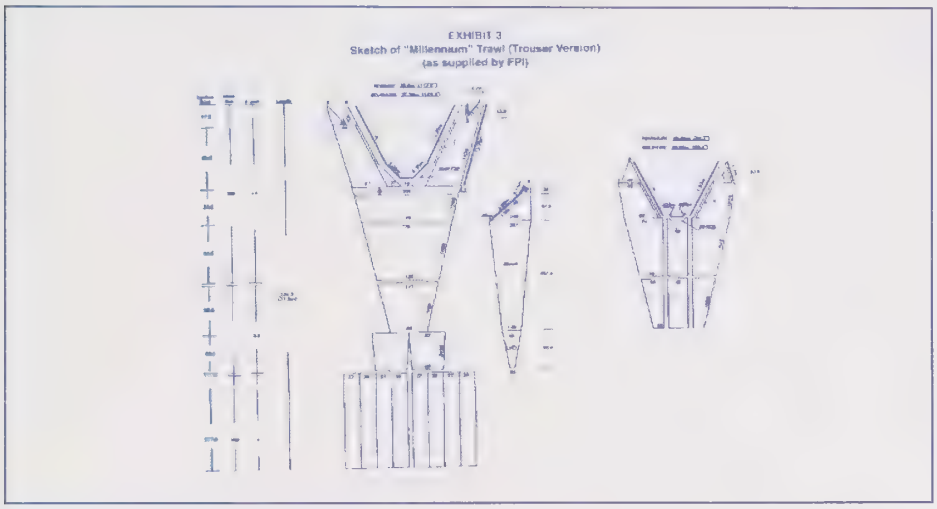
During the Spring of 2000, members of an Atlantic Industry Advisory Turbot Working Group, including Fisheries Products International (FPI) suggested that the work begun in 1998 be continued. FPI offered to support tests to study the selectivity of a 145 mm mesh codend and the effect of small mesh in the entire forward and middle section of the new "Millennium" trawl. The "Millennium" trawl was tailored to incorporate some main gear design features that when combined make the gear more energy efficient and selective.

*Project Vessel F.V. "Pennysmart"*

Two main experimental trials were undertaken during the 2000 turbot fishery using the "Millennium trawl aboard the F.V. Pennysmart with the following objectives;

### *Experiment 1 -At-sea Trials to Determine the Selectivity Curve of a 145 mm Codend (standard gear) use in Standard Millennium Trawl.*

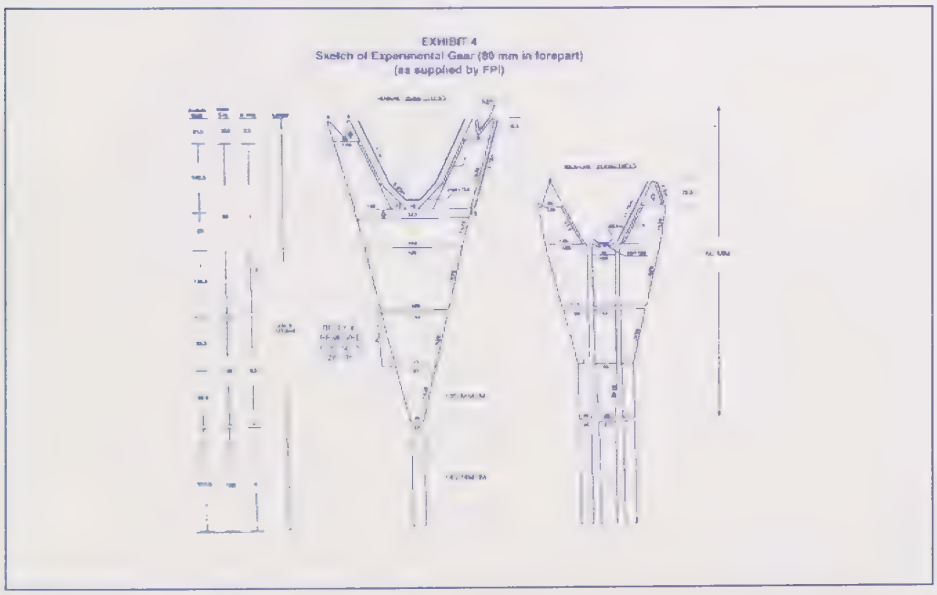
To obtain the selectivity of the standard trawl, the millennium trawl was divided into two sections, or trousers, by a vertical panel. Attached to one side of the panel was a standard codend having a mesh of 145 mm and attached to the other was a control coded end having a small-mesh, non-selective liner (50 mm) installed inside a 145 mm codend.




*"Millennium" Trawl (Trouser Version)*

### *Experiment 2 - At-sea Trails with modified Millennium Trawl Incorporating Small Meshes (80mm) in Forepart of the Trawl.*

Alternate hauls were conducted with a modified millennium single codend trawl with small mesh (80mm) forepart (with and without liner).




*"Millennium" Trawl (80mm in Forepart)*

### *Results*

The 145mm codend selectivity study was very successful. Analysis of data showed the 145 mm codend to have a L50 (defined as the fish length at which 50% of the fish of a given species escape and 50% are retained) of 47.74 cm. This compares to the L50 of 37.6 for a 130mm mesh coded previously reported by Spain.

There was clear indication that use of small mesh (80mm) in the forepart and body of the trawl prevents meshing, resulting in a reduced number of small turbot in the catch. However, further experimental work with the "millennium" trawl and other trawls incorporating small mesh in the fore part will be required to establish a precise level of improved selectivity. This will involve a large number of individual tows for comparison, ensuring validity and reliability of results.

***Preliminary results indicate that elimination of the meshing (which comprises a large percentage of small fish) allows the codend to provide for the escape of small fish, thereby decreasing the overall catch of small fish. It was again found that leaving large mesh in the second belly resulted in much meshing in that part of the net.***

Based on the promising results obtained, work will continue in an attempt to establish effectiveness of using small mesh in the forepart of the net in preventing meshing and to allow the codend to selectively select and release the small turbot, and to assess the overall impact on energy consumption.

### *Project Participants*

- The Department of Fisheries and Oceans, Responsible Fishing Operations, supported by PERD funding.
- Captain and crew of the F.V. Pennysmart, owned and operated by Fishery Products International (FPI)
- Canada/Newfoundland Fisheries Diversification Program
- The Marine Institute of St. Johns, Newfoundland

## On-going Developments in Selectivity of Turbot Trawls

Improved selectivity of turbot trawls ensures energy savings in the following ways:

a) If the gear is more selective, operations can continue on productive grounds where gear damage is rare. Accordingly, there will not be a need to steam around seeking new areas (traditional or new) where there is a reduced level of small fish in the turbot stock. Less steam time will result in less fuel consumption.

b) With less meshed fish and well-selected fish, there will be a reduction in sorting time (removal of meshed fish) making the harvesting process more efficient. The reduced operational time will translate into less fuel consumption necessary for the vessel to catch its quota.

c) Most meshed fish are damaged and have to be discarded. With the elimination of meshing and discards, there will be a resulting 2-3% savings in operational and fuel costs.

These savings also have environmental and resource conservation advantages.

Recognizing the advantages of work accomplished through PERD and other inputs as seed funding, the industry has continued with experimental work, largely at their own cost. Approximately 60 days of fishing have been completed on various northern turbot fishing grounds at a cost of over $200,000. Clearwater Fine Foods Inc. have added to the data collected by FPI and have confirmed that having the forepart of the trawl constructed of small mesh can radically reduce meshing, which in turn offers resource and energy savings. It has been shown that discards can be reduced from 4.3% to 1.8%, representing a direct saving of 2.5% in operational costs.

The Turbot Industry Working Group are planning further experimental work with selectivity and design of gears to take place in the 2001 fishing season.

## Improving the Efficiency of a Shrimp Selectivity by-Catch Grid

This project was conducted to evaluate a new prototype shrimp selectivity by-catch grid design, which utilizes new lighter weight materials of construction instead of traditional stainless steel. The design considered key operational considerations including crew safety, ease of operation, and cost, as well as ensuring that it would not adversely impact overall fishing productivity or performance of the trawl.

The prototype selectivity grid has upright separators constructed of plastic covered stainless steel wire. These uprights are easily replaced if required, and also have a tensioning facility. This design has several potential benefits in that the available surface area will increase by 20% and it would improve the selectivity features. It will also enable the construction to be 60% lighter, and therefore increase the safety factor. This revolutionary design is also expected to decrease drag and reduce fuel costs.

*Project Vessel*
*M.V. "Northern Eagle"*

The shrimp Twin Trawler the M.V. "Northern Eagle" was selected from the offshore shrimp fleet and supplied with a prototype grid, which was tested against a conventional grid. The experimental grid assembly was supplied installed in a netting section with similar dimensions to the vessel's conventional grid. The grid was tested under commercial fishing conditions in normal fishing areas.

### Results

The prototype grid was tested against a conventional stainless steel grid using the Twin Trawl system. Twenty at-sea comparison tows were completed, mostly in the Hopedale Channel off Labrador, and there was an equal distribution of shrimp from both types of grids.

- The crew quickly noticed the difference in weight between the two grids and any twists in the prototype grid could be removed manually, whereas the winches had to be employed in a similar situation with the stainless steel grid.

- The grid indicated a gradual decrease in angle, which indicated reliability in identifying an increase in catch retained in the codend.

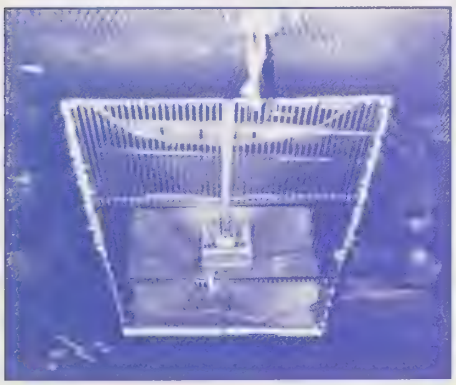
- Catch composition with the two grid types was identical throughout the experiment (with the exception of one tow where the catches were unequal because the trawl with the experimental grid had major belly damage), the by-catches were the same amount and consisted of small amounts of juvenile Turbot.

After 20 tows were made using the trawl with the experimental grid, the crossbars were damaged by a succession of large boulders. It was not possible to repair at sea and the use of the grid was discontinued. The trials identified areas where modifications to the current design would improve performance.

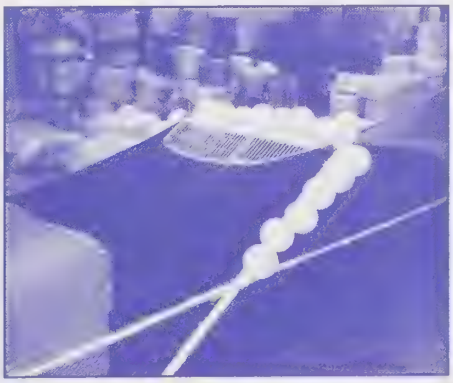
***The principle of using plastic coated wires as uprights worked well during the 20 tows and the grid design concept graded shrimp efficiently. It was also rugged enough to withstand the rigours of a normal working environment on a large stern trawler. A smaller version of the present design could be used with success on smaller inshore vessels, and contribute to energy savings.***

### Project participants

- The Department of Fisheries and Oceans, Responsible Fishing Operations, supported by PERD funding.
- Captain Ulf Snarby of the "Northern Eagle", and the Osprey Fishing Company of Sydney, Nova Scotia, the vessel owners.
- Scantec Limited, of Dartmouth, Nova Scotia.



*Experimental Grid*



*Experimental Grid Installed*

# Other Projects Underway

In addition to the completed projects described above, other initiatives are presently in progress.

## B.C. Salmon Fuel Energy Conservation Study

One project was initiated in the fall of 2000 by the British Columbia Area D Salmon Gillnet Association to collect the baseline data with respect to historical and current levels of fuel consumption in the Pacific salmon gillnet fishery.
The objectives are to:

- Measure and record the amount of fuel consumed during experimental gillnet fishing operations (steaming, setting, net hauling) with new gear and methodologies.
- Obtain historical empirical data on fuel consumption and costs incurred in previous fishing seasons.
- Assess the benefits and our understanding of how Real Time catch reporting can enhance our ability to conserve and reduce overall fuel consumption.

An attempt will be made to correlate the relationships (if any) between fuel consumption and recent selectivity adaptations implemented in the Area D gillnet fishery (i.e. time of day restrictions, gear configuration and area). Once methodologies are identified to reduce fuel consumption and environmental emissions, the results of this research can be transferred into other fish management areas and gear sectors. The goal is to reduce the amount of fuel consumed and demonstrate that the gillnet fleet can be efficiently deployed in Pacific fisheries. At-sea investigations were initiated in November of 2000, with completion of remaining trials scheduled during the 2001 summer sockeye fishery. It is expected that these tests, in conjunction with existing data on selective harvesting methods and real time catch reporting, will provide enough information to design fisheries which would enable Area D gillnet fishermen to achieve their Sockeye and Chum allocations with the least possible impact on the environment, Coho and stocks of concern.

### *Project participants*

- The Department of Fisheries and Oceans, Responsible Fishing Operations, supported by PERD funding.
- Area D Salmon Gillnet Association
- The Department of Fisheries and Oceans, Salmon Selectivity Program.

## Evaluation of Semi-Pelagic Trawl System for Reduction of Drag and Reduced Seabed Contact

The goal of this project is to produce an improved fishing gear design system for harvesting shrimp for vessels of about 55 to 65 feet in length, which will reduce fuel consumption while at the same time lower the impact of trawling on crab stocks and the sea bed.

Semi-pelagic operation of the trawl will be achieved by raising the net just clear of the sea bed leaving only the trawl doors in some contact with the sea bed.

The methodology adopted for this on-going project included the use of flume tank testing of a scale model of Nordsea's 1110 shrimp trawl and a "French Bridle" rig to achieve a semi-pelagic operation.

Following the completion of the tank testing, sea trials will be carried out according to a scientific protocol that has been prepared specifically for the project. Full scale fishing trials will be conducted on commercial shrimp ground to determine what energy (fuel savings) can be obtained under commercial fishing conditions, as well as impact on the sea bed. An alternate haul system making full use of the twin drum on the vessel will be adopted to compare shrimp catches while the geometry and other engineering performance parameters of the trawls will also be measured.

The experimental tests at sea are expected to coincide with the spring of 2001 new quota openings.

### *Project participants*

- The Department of Fisheries and Oceans, Responsible Fishing Operations, supported by PERD funding.
- The Department of Fisheries and Oceans, Canada-Newfoundland Fisheries Diversification Program.
- Captain Craig Hussey, owner/operator of the "Canadian Navigator II".
- Nordsea Limited of Dartmouth, Nova Scotia.
- The Marine Institute of St. Johns, Newfoundland, supported by the Canadian Center for Fisheries Innovation.

## Sharing New Developments

These trials are all being conducted jointly with government, industry, and research institutes to improve the net economic benefits to the fishing industry, while at the same time ensuring that new technologies are energy efficient and environmentally sound. DFO's goal is to ensure these results are shared with all stakeholders, and encourage their feedback and participation in future developments.

The results of these and other developments in gear design and selectivity, energy conservation and environmental issues related to fishing were presented and discussed at the **North Atlantic Responsible Fishing Conference (St. Johns, Newfoundland - November 7-9, 2000)**. The Conference brought together some ninety participants, including 60 practicing fishermen from five North Atlantic countries, together with a number of other technical, industry and government representatives.

Conference activities included technical presentations, demonstrations and working group discussions, and full advantage was made of the conference location at the Marine Institute through flume tank demonstrations of many of the fishing gears and pieces of equipment being discussed.

A critical peer review was invited and completed for several projects discussed here, to ensure that feedback and suggestions are received. In addition, videos describing the process and results were made, and included in Responsible Fisheries training programs.

In addition to the North Atlantic Responsible Fishing Conference, the results of the projects were presented to thousands of fisherman and industry participants at two major North American Fisheries Exhibitions: "Fish Expo" in Rhode Island (October, 2000) and "Fish Expo" in Seattle, Washington (November, 2000).

*Flume Tank Demonstration at Marine Institute of Memorial University, St. Johns Newfoundland*

## Industry Feedback and New Collaborations

There has been substantial national and international interest in the energy reduction potential of the new gear, components and techniques developed and tested in the projects described above as a result of major media coverage in regional, national and international trade journals. The technologies are already being further developed and applied in Europe and the northeastern United States.

Based on the promising results, industry is in the process of establishing an interim committee comprised of key national and international representatives leading to the establishment of a North Atlantic Responsible Fishing Council to further develop technologies and promote information exchange and collaborations. Interest has also been expressed to extend collaborations through two international North Atlantic Fishing conferences to further this goal, and plans are underway to organize them for the Fall of 2001.

In addition, plans are also underway to include Fisheries Energy Efficiency display booths at regional, national and international fisheries trade exhibitions to transfer the results of the projects undertaken to Canadian fishers and industry, and provide for the exchange of technical information.

***Development of new and better gear technologies will benefit us all. We will continue to communicate success stories such as these, and welcome your contribution and participation in the process.***

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